



Title: CERTAIN PROBLEMS IN THE COMPLETE MECHANIZATION OF COAL MINING
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Source: Izvestiya Akademii Nauk SSSR, Otdeleniye Tekhnicheskikh Nauk,
No 7, 1949, pp 1038-1048 [redacted] July 1949,
Russian monthly periodica.

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CERTAIN PROBLEMS IN THE ^{COMPLETE} ~~COMPLEX~~ MECHANIZATION
OF COAL MINING

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The purpose of this article is an attempt to select the basic elements and machines for a combined mining unit which, continuously and simultaneously, would secure efficient extraction of coal, its leading and delivery to a drift tunnel, protection of the working space in a stope and control of mining pressure.

1. Types of combined mining units.

Factors which determine the combining of mining equipment into an efficient system are as follows: 1) ~~application~~ ^{of use} conditions; 2) direction of stope advance; 3) coal quality, structure and depth of the coal seam; 4) particular properties of the top and method of controlling mining pressure.

According to their application the combined units may be divided in two groups: equipment for slanting seams and combined units for steeply dipping ones.

Both groups also may be subdivided according to direction of stope heading, into two groups: units for extraction by wide benches along the dip or rise of a coal seam and equipment units for extraction along the course of a seam.

This work has the purpose of solving the problem for the flat slanting beds of the Donets Basin and therefore possible combinations of mining equipment may be limited to certain definite complexes of machines.

Transportation of coal in the long stope drift requires employment of the scraper conveyor, dependable in operation and permitting, in case of necessity, moving of coal cutters along the conveyor frame.

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The essential member of the combined mining unit is a shielding mechanically moved device which supports the top in the space near the stope and regulates the mining pressure. Necessity of coordinating the dimensions of extracting machines and mechanized support determines the width of the coal streak under operation.

Movement of the support can not be realized without its release from the roof pressure, and this factor predetermines construction of the sectional support which would permit relief of pressure on sections in succession without leaving all near-stope space unsupported entirely even for a short period.

2. Section of extracting machines for a combined unit.

The following technical, economic and production indexes may be accepted as criteria for comparison of extraction machines: 1) the hourly or shift production of the machine and continuity of its performance; 2) operational dependability of structural members executing separation of coal from a coal seam; 3) the amount of labor required for producing 100 tons in the limits of the stope or mechanized section; 4) the specific consumption of power for 1 cubic meter of produced coal.

Combine machines for stopes of slanting seams are divided into two large groups: machines permitting application of explosives for breaking and machines excluding explosives. The first group consists of machines which permit unavoidable interruption in operations during the time required for blasting.

3. Combine machine and units ^{used with} ~~with using~~ the explosives for coal breaking.

To this group belong the ZAL-aggregate and cutting-loading VPM-1 machine of the Martynenko system. Both machines were tested in the seam of 1.7 meter thickness in one of Donets Basin mines and showed entirely positive results. The stope length in the case of testing the ZAL-1 was 17 meters and the angle of seam slope was 2 degrees. Cutting was done with a cutting chain of special design simultaneously along the whole length of the 17-meter stope. The machine showed high daily production capacity of 175-206 tons which corresponded to 7.3-8.5 tons

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per labor man. The forward travel of machine was executed without any dis-assembling simultaneously with cutting and sometimes with loading of coal broken by explosion.

Evaluating the machine according to criteria outlined in the previous part, the following conclusions may be drawn: a) the hour and shift production capacity may be sufficiently high; complete continuity of operation is not attained when using explosives, however there is a possibility of using this machine in combination with flameless means of blasting; b) operational dependability is tested at present for a working length up to 18 meters, but it is reasonable to expect construction of an equally dependable unit with a working length up to 30-40 meters; c) the specific consumption of electric power is not higher than 0.2-0.3 kilowatts per cubic meters, in as much as the chief role in the process of coal extraction is played, in this case, by explosives.

A unit of the ZAL type may be recommended for use in tough coals embedded in stable rock at an angle of slope up to 6-8 degrees and with a seam thickness of over 1.0 meter.

The cutting-loading VPM-1 machine of the Martynenko system operates under approximately similar conditions but in a wider range of seam thickness. It may be used in seams of thickness as low as 0.45-0.5 meters.

4. Coal combines based on accelerated cutting and self-loosening of benches between cuts.

This group embraces almost all coal combines in practical use in coal mines of the Soviet Union and abroad. As a working member, these machine use profile (WOM-1, 2) or circular ("Donbas") bar or combination of several straight, bent or circular bars and rods equipped with teeth and often with cutting discs (systems of Makarov, Ab^akumov UKA-1, MEK and others).

The coal seam is divided in this case by cut-in slots into several benches which under the action of vibrations caused by the moving teeth of cutting chains and rods must be broken down to chunks suitable for loading on the conveyor.

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As a rule, combines of this group have a low per-hour production capacity, considerable consumption of electric power per unit volume and insufficient dependability in the process of coal separation, inasmuch as breaking and loosening of inter-cut benches are not executed directly by working members of the combine.

The single exception from this rule is the coal combine "Donbas" which, in addition to the circular cutting bar and rod with 2-3 discs, is equipped with a power circular loader, scrapers of which easily loosen inter-cut benches of the coal seam.

Considerable dust formation in the operating process is an essential disadvantage of combines working on the principle of accelerated cutting [3]. There are devices for wetting coal in cut-in slits only in the "Donbas" combines and in the latest model combines of the Makarov systems. Observations of the Makeevka Scientific-Research Institute established that the concentration of coal dust in the air may be lowered with the aid of water from 25-30 to 6-8 grams per cubic meter. It may be expected that the figure will be reduced even further by the use of wetting agents recommended by the Institute of Mining and as personnel become more experienced.

The increased crushing of coal by combines of this group is also a great operational disadvantage with respect to anthracites.

5. Coal mining combines based on utilization of accelerated cutting and devices for mechanical and hydraulic breaking.

The construction of a mechanical breaking device is a complicated problem not yet solved in any of the existing combines. Application of hydraulic crushing cartridges of the Serdyuk system (combines C-24/III, C-40) in combination with the circular or bent cutting bar is the best solution to this problem but is not yet tested in operation. The chief disadvantage of hydraulic cartridges is the necessity of stopping the working combine every 0.5-0.7 minutes.

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The designing of a coal combine with a mechanical or hydraulic breaking system is an urgent current problem. Good results may be obtained by investigations in the field of flameless blasting.

6. Machines separating large chips of coal.

Machines based on separation of coal from a seam face by shearing [4] give, under certain conditions, production not lower than that of coal combines. Their specific feature is a nonuniform output from a longwall caused by moving the drift conveyor after every chip separated from a coal seam.

Consumption of electric power per unit volume of coal is insignificant, 0.25-0.6 kilowatt - hours per cubic meter.

7. Movable metal supporting system.

There are three types of travelling metal supporting systems: system supporting the roof and controlling mining pressure; system supporting the roof but without pressure control; and enclosing system without roof support or pressure control.

The system of the first type has strong vertical brace members on the side of the excavated space and must be a first choice for use in mechanized stopes. There are several designs of this type, namely: the sectional support of "Ugle-mashproekt", system of the "Kuzbasugol" combine and the one-piece support of the Pshenko system.

The frame supports of the Levkovskiy system belong to the second type, and the third type of supports is represented by the shield of the Zhuravlev system based on the principle of free collapsing. The latter type is considered as unsuitable for use in coal mining with a combined mining unit.

The frame supports are being tested in operation with the WOM-2 coal combine.

8. Conveyor for coal transportation along the stope.

The scraper conveyor is recognized as the most efficient transportation device for operation with coal extracting machines. The working capacity of the conveyor must be not less than 150-200 tons per hour; the length 200-230 meters.

Corresponding production must be maintained by reloading short conveyors installed in cross cuts. It is necessary that the conveyor permit loading of coal at any point of the long-wall.

Following technical-economic indexes were established by planning operations for a combined mining unit working in a seam of 1.3 meter thickness; daily production 440-590 (depending on the width of the coal streak extracted during a single cycle, 0.9 or 1.2 meters); personnel in the stope - 38 men; productive capacity - ~~11.6~~ ^{11.6} tons per man for one shift which corresponds to labor consumption of 8.6 working days per 100 tons of coal; daily advancement of the stope 1.8-2.4 meters.

Conclusion

The present article may be considered as a substantiated problem for construction organizations in coal machine building on designing a combined unit for extracting coal in long stopes of sloping seams.

Suggested requirements are based on investigations conducted in the Institute of Mining of the Academy of Sciences of the USSR in 1948 under the supervision of academician A. M. Terpigorev and discussed in a seminar with representatives of scientific-research and designing institutes and the Ministry of Coal Industry.

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